FIRM'S PERFORMANCE THROUGH ITS ROLE AND INTERMEDIATION IN THE CLUSTER KNOWLEDGE SYSTEM: A QUESTION OF BALANCE

PRELIMINARY DRAFT

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Abstract

Wide attention has been given to the development and existence of a "cluster knowledge system" driven by networks of firms' relations. While firms vary remarkably in terms to their contributions to the "cluster knowledge system" depending on their role as sources, absorbers or mutual knowledge exchangers, their own benefit from these roles in terms of individual performance remains unclear. This paper explores this issue, taking into consideration (1) the performance implications of differing firms' roles and (2) the moderating effect of the firm's intermediation in the "cluster knowledge system" on the association between differing firms' roles and its performance. The paper builds and contributes to both the network and cluster literatures.

Keywords:

Clusters, Social Network Analysis, Information Exchange, Performance

Firm's performance through its role and intermediation in the cluster knowledge system: a question of balance.

1. Introduction

The so-called industrial cluster has been considered as a particular case of organizational networks. In this literature wide attention has been given to the existence and implications of heterogeneous firms' contributions to the cluster knowledge system through the existence of unevenly distributed networks of relations (Lissoni and Pagani 2003; Dahl and Pedersen 2004; Giuliani and Bell 2005; Bell and Zaheer 2007; Boschma and Ter Wal 2007; Giuliani 2007; Morrison 2008). Authors like Giuliani and Bell (2005) have referred to varying firms roles in the cluster knowledge system distinguish among what they labeled firms' absorbers, sources, and mutual knowledge exchangers. These types of firms have remarkable differences in their knowledge contribution to the cluster. Although the implications for the whole cluster of these varying firms' roles have been explored (Giuliani and Bell 2005), their own benefit in terms of individual performance remains unclear. This paper aims to analyze potential differentiated performance effects produced by each alternative firm's role in the cluster knowledge system (As a source, receiver or mutual exchanger).

Moreover, given that the relational view, in which we build our arguments, claims that the positioning of the organization in the network may explain, better than other factors, its outcomes, we consider that it is interesting to explore the moderating effect of the firm's intermediation in the cluster knowledge system in the association between its role (absorber, source or mutual exchanger) and performance. Therefore, we build on recent research that highlights the advantages firms could gain from their network position, particularly exploring the implications of a firm's intermediation in a knowledge network.

The empirical research is based on a sample of companies belonging to the Spanish ceramic tile cluster. The ceramic tile industry is distributed around the world mostly in clusters. In addition it has emerged as a dynamic and fairly knowledge-intensive activity. Our study adds to recent research in the field of networks, providing evidence of the effects the balance between the knowledge a firm provides and receives from its network of relations. In addition this paper contributes to the specific cluster literature shedding light of the processes clustered firms use to improve performance.

The paper is structured as follows: first we describe theoretical considerations then we justify hypotheses. Next, we present methods and empirical section, including findings, and finally we discuss conclusions and implications of the findings.

2. Theoretical Framework

2.1. Uneven distribution of resources in clusters

Recent cluster literature evidenced that firms do not participate in cluster knowledge exchanges in a selective uneven manner (Lissoni and Pagani 2003; Giuliani 2007; Morrison 2008 among others). Exchanges access is restricted to subgroups within the network (Lissoni 2001; Giuliani and Bell 2005; Malipiero, Munari et al. 2005; Boschma and Ter Wal 2007). Consequently we can conclude that knowledge spreads unevenly among members of a local cluster (Giuliani and Bell 2005). This unevenness or heterogeneity is caused by the internal diversity of the cluster's firms, and also leads to diverse consequences for the local networks (Camuffo 2003).

Acceptance of the internal heterogeneity in these network structures has implied a step forward in the research on clusters. Similarly, the findings of Morrison and Rabellotti (2009) supported the idea that knowledge flows are restricted to a tightly closed group of local producers, which are significantly different from the rest of the members of the group. Moreover, Giuliani and Bell (2005) found strong support for the idea that companies can transfer knowledge asymmetrically, i.e. knowledge sharing can occur even when reciprocity is not happening (Bouty 2000).

Beyond the interest in network relationships between firms in the cluster, this literature recognizes the fundamental role of focal firms whose characteristics and relationships are considered responsible for the heterogeneous distribution of knowledge in clusters. Focal firms (including leading firms, anchor tenants, strategic centers, brokers or gatekeepers) are not only fundamental to its superior ability to coordinate and guide other enterprises in the cluster for innovation, but the key to relevant knowledge transfer between companies located both inside and outside the cluster (Boari and Lipparini 1999; Lazerson and Lorenzoni 1999). Looking at the development of this approach is evident a growing interest in the relationship between the focal firms with other firms and institutions located outside the cluster. This most recent literature shares an interest in access to external knowledge and therefore focuses mainly on the gatekeepers, defined as a specific type of agent, saving external organizations with local, transferring their knowledge to cluster firms (Morrison 2008; Wink 2008; Giuliani 2011; Graf 2011) and eventually combining them with local knowledge (Graf and Kruger 2011; Munari, Sobrero et al. 2012).

2.2. Performance implications of firms varying roles in the cluster knowledge system

Authors like Giuliani and Bell (2005) have used the balance between outdegree and indegree scores to determine different cognitive positions of the actors in a network allowing them to distinguish absorbers, sources, and mutual information exchangers. These types of actors have remarkable differences in their knowledge contribution to the cluster. Although the whole cluster may profit from the knowledge and information provided by source actors, their own benefit in terms of individual performance is unclear.

Probably it can be found contradictory arguments and evidences on the effect to be absorber or source in the exchange network. Although intuitively, a firm receiving informational inputs clearly benefit to exploit them internally. It is also true that firms sourcing information to the network benefit from a powerful position, and are in better condition for reciprocity and other relational benefits.

Hence, we consider that is interesting to test the influence of these different cognitive positions and their effects on individual cluster firms' performance, without postulate the sign positive or negative of these effects.

H1 The firm's role in the cluster knowledge system (absorber, source or mutual exchanger) will affect its performance.

One of the important uses of the social network analysis is the identification of the most relevant actor in a social network. That is the main purpose of the centrality measures employed in this type of analysis. Among centrality measures we can commonly find those that are based on degree, betweenness and closeness of the actors. These indicators attempt to provide a quantitative measure of the importance of an actor in a network (Wasserman and Faust 1994). Betweenness centrality, for example, measures the frequency with which an actor falls between other pairs of actors on the shortest or geodesic paths connecting them (Freeman 1979). This index can provide quite different measures of centrality than those provided by degree or closeness indices. This means that actors that have large *degree* or *closeness* results, that is, have a good level of direct ties and are near, in geodesic terms, to others can have small betweenness scores if they do not occupy structural advantageous positions. Hence, the higher the betweenness score of an actor, the greater the capacity of that actor to act as a structural conduit connecting others in a given network (Mehra, Kilduff et al. 2001). This concedes the actor that is intermediating a certain power in the sense that he can decide whether the information is transmitted to other actors or not. In this line, some researchers find that betweenness indices are appropriate to explain the performance of the actors in a network. Some authors (for

example, Mehra, Kilduff et al. 2001; Cross and Cummings 2004; Kidane and Gloor 2007; Reinholt, Pedersen et al. 2011; Krajenbrink 2012) have related betweenness indices with different kinds of performance finding in most cases that the higher the betweenness scores the better the performance is, even though, in some cases, the influence of betweenness is affected by other variables as Reinholt et al. (2011) indicate.

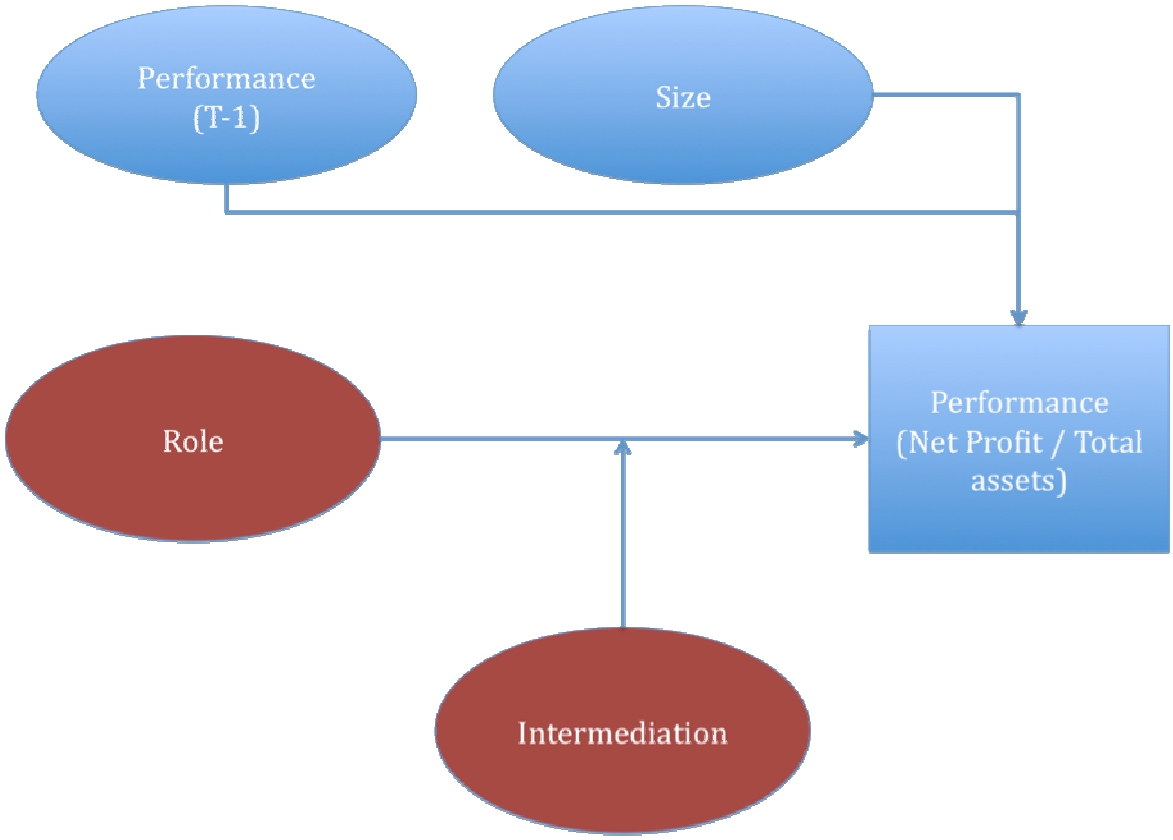
Betweenness indices measure whether an actor is involved in the transmission of information but it does not take into account if the importance of that actor is a consequence of receiving or transmitting that information (Wasserman and Faust 1994). Apart from centrality there are other measures that aim to identify prominent actors in a given networks. In fact, Knoke and Burt (1983) consider an actor to be prominent if its ties make it particularly visible to other actors in the network. These authors distinguish two types of prominence one that comes through centrality, already reviewed, and other that comes through prestige. We can define a prestigious actor as one who is the object of extensive ties, thus focusing solely on the actor as a recipient (Wasserman and Faust 1994). Under this definition actors with higher scores of indegree become more prestigious as they are the objects of more ties. In fact, indegree is the most basic index of prestige social network analysis. However, this will depend on the type of information exchanged in a given network. In some cases prestigious actors will be those ones that send information (outdegree) rather than the ones that receive it (indegree), like those networks where the relation involves some kind of advice.

From the above argumentation can be argued that the intermediation of a firm influences on how resources exchange and are exploited by firms and consequently to firms' performance. We can express this hypothesis.

H2 *The firm's intermediation in the cluster knowledge system would act as moderator in the association between its role (absorber, source or mutual exchanger) and performance.*

We can draw our theoretical proposition as follows:

Figure 1. Theoretical model



3. Methods

3.1. The Context

The empirical study is based on the ceramic tile industry, in this case in Spain. This geographic area covers a 20 kilometer radius and accounts for 90 % of the Spanish production of wall and floor tiles. In general terms, the tile industry is distributed around the world, mostly in cluster-type geographical concentrations. The ceramic tile industry has emerged as a dynamic and fairly knowledge-intensive activity. Indeed it can be considered a very dynamic industry as regards technological advances, which are focused particularly on process and product improvements (Fernandez de Lucio, Gabaldón et al. 2005).

In this cluster, as well as companies there are local institutions and supporting organizations that provide advice and other services to firms. These institutions are universities, technological institutes, policy agents, business associations, etc. Previous research on clusters has identified and analyzed, the Spanish ceramic sector. In works such as those by Ybarra (1991), Boix and Galetto (2006) and Boix (2009) this industrial context has been identified as a Marshallian industrial district, while Porter (1990) mentions its existence when studying the main competitors of the Italian ceramic cluster. In addition, Molina- Morales (2002) describes the process of knowledge creation and innovation in the cluster. Finally, Molina- Morales et al. (2002) and Molina-Morales (2005) analyzed the specific mechanisms and the role of local institutions in the transfer of knowledge within the cluster.

3.2. Data

This study uses data collected in the Spanish ceramic cluster through surveys and interviews with the companies. These interviews have focused on managers and engineers leading the R & D activities and the most relevant aspects of the business. Given the characteristics present in the ceramic companies we believe that this profile is the most suitable for the collection of information through our questionnaire (Table 1). The survey was conducted between February and July 2011 and focused on different industrial activities within the cluster, such as: manufacture of wall and floor tiles, ceramic frits and glazes, machinery and equipment, decorative pieces, atomized clay and chemical additives (Table 2). The end result of the survey is that we could obtain 166 questionnaires in a total universe of 238 companies in the sector which represents 69.75% of the total. The selection of companies to interview has been done under the supervision of industry experts from companies, industry associations, local university, research centers etc. These experts have given their approval to the sample based primarily on the fact that the most important players in the sector are included in the collected surveys.

Table 1. Respondents' Profile

Position	Number of Interviewed	%
General manager	61	36%
R&D director	48	29%
Chief technical officer	41	25%
Other staff members	16	10%
Total	166	

Table 2. Sample Distribution by Cluster Productive Activities

Activities	Number of Companies	%
Ceramic wall and floor tile producers	83	50.0
Glaze and frit producers	21	12.7
Machinery and equipment producers	36	21.7
Special and decorative ceramic pieces producers	16	9.6
Atomized clay producers	6	3.6
Chemical additives producers	4	2.4
Total	166	100

3.3. Questionnaire

To measure the exchange of business information between companies we have prepared questions that investigate in two directions. That is, we asked respondents about the destination and source of business information exchanged with other companies. To collect this relational information we used a roster-recall method giving each respondent a list of names of other companies in the cluster besides certain spaces that let them include their own suggestions. Based on this list we made the following questions: (1) as a receiver (Question 1*), Have you received information about diverse aspects of the business from the firms mentioned in the roster? If you have received information from firms not mentioned in the roster please fill in the blanks*. As a source, (Question 2) *which of the firms and organizations mentioned in the roster has benefited from your information about diverse aspects of business? If a firm has benefited from your information and it is not in the roster, please fill in the blanks*. Business information includes aspects such as, market information, new business opportunities, new vendors and suppliers, availability of inputs, characteristics and performance of machinery and technology, regulations and legislation, grants, etc.

We have also used data that comes from secondary sources. In this case we obtained all the financial data from SABI database. We were able to gather the last net profit / total assets ratio of each of the companies surveyed and also this value for the previous year. We used this information as some of the variables included in our model as we explain in the following section.

3.4. Variables

In order to test the hypothesis proposed in our theoretical model we have used a certain set of variables that where introduced in different regression models whose outputs are described in the results section.

Performance: The dependent variable in the model is calculated dividing the firm's net profit by the total assets.

Size. This is our first control variable and it is based on a factor analysis of the following items: (1) Number of employees, (2) total assets, and (3) total revenues for the last year. We can assume that greater organizations have more capacity to generate revenues, economies of scale and hence, have a better performance.

Previous Performance. This is also a control variable calculated as the dependent one but applied to the results of the previous year. In this way we can control if the performance in the past is influencing the actual one.

Firm's Role: This indicator measures the ratio between the knowledge transferred (*Outdegree*) and received (*Indegree*) by each firm. Thus, four categories can be found:

- ABSORBER: If O/I is < 1, the firm is a net absorber of Information.
- SOURCE: If O/I is > 1, the firm is a net source of Information.
- MUTUAL EXCHANGER: If O/I is 1, the firm engages in the mutual exchange of Information.

We consider this as an independent variable that can have a direct effect on firm's performance.

Intermediation. Betweenness centrality is a measure that considers the position of nodes in between the geodesic or shortest path that links with any other node in the network. This network indicator can be interpreted as a measure of the control that an actor has over the flow of information between others (Newman 2005). In addition, some authors consider the betweenness centrality as a measure of the power that an actor has within the network (Freeman 1978; Brass 1984). Thus, we consider that those actors who possess high values of this brokerage indicator could benefit from their powerful position in the network increasing their business performance. In our specific model we consider that this variable can have a moderating effect on the net contribution.

4. Results

In order to test individual and interactive effects between the firm's role and its intermediation we introduced the groups of independent variables step by step (Hair, Anderson et al. 2006) for each of the three categories considered: Source, Absorber and Mutual Exchanger. In the first model we included the control variables, size and previous performance. In model 2, we introduced the variables corresponding to the simple or direct effect of the firm's role, and in model 3 we added the intermediation variable. Finally, in model 4, we introduced the interactive effects.

Our results show how Hypothesis 1 is confirmed for the source and mutual exchanger roles while in the case of the absorber there is no significant influence over the firm's performance. On the other hand Hypothesis 2 is supported completely by the results as in all cases the intermediation variable is a significant moderator on the association between differing firms' roles and its performance. In general terms we see that in all cases the intermediation variable has a positive effect on performance as per the values shown in tables 3, 4 and 5. Furthermore, the control variables do not have significant effects on firms' performance except in the case of the model that studies the absorbers where size has a significant negative effect on performance. This last result may not be so relevant if we consider that this particular model has the worse overall significance. In any case we analyze in detail the specific results of each role in the following sections.

Table 3. Results for information sources

	Model 1		Model 2		Model 3		Model 4	
	B	**Error**	**B**	**Error**	**B**	**Error**	**B**	**Error**
Constant	.000	.078	.000	.078	.000	.073	.107	.067
Previous Performance	-.029	.079	-.029	.079	.027	.075	-.009	.066
Size	.005	.079	.021	.081	-,155*	.085	-.016	.077
Source			-.078	.080	-.125	.076	-,174**	.068
Intermediation					0,397***	.084	,564***	.078
Source * Intermediation							-,510***	.074
Adjusted R2	-0,011		-0,012		0.105		0.304	
Sig. Change in F	-		-		***		***	

N=166; *** p<0.01; ** p<0.05; * p<0.1. Non-standard coefficients

Table 4. Results for information absorbers

	Model 1		Model 2		Model 3		Model 4	
	B	**Error**	**B**	**Error**	**B**	**Error**	**B**	**Error**
Constant	.000	.078	.000	.078	.000	.074	-.040	.076
Previous Performance	-.029	.079	-.032	.079	.024	.076	.037	.075
Size	.005	.079	-.002	.079	-0,173**	.085	-205**	.085
Absorber			-.060	.079	-.008	.076	-.045	.077
Intermediation					0,377***	.085	0,278***	.097
Absorber * Intermediation							-,221**	.105
Adjusted R2	-0,011		-0,014		0.09		0.109	
Sig. Change in F	-		-		***		**	

N=166; *** p<0.01; ** p<0.05; * p<0.1. Non-standard coefficients

Table 5. Results for mutual exchangers

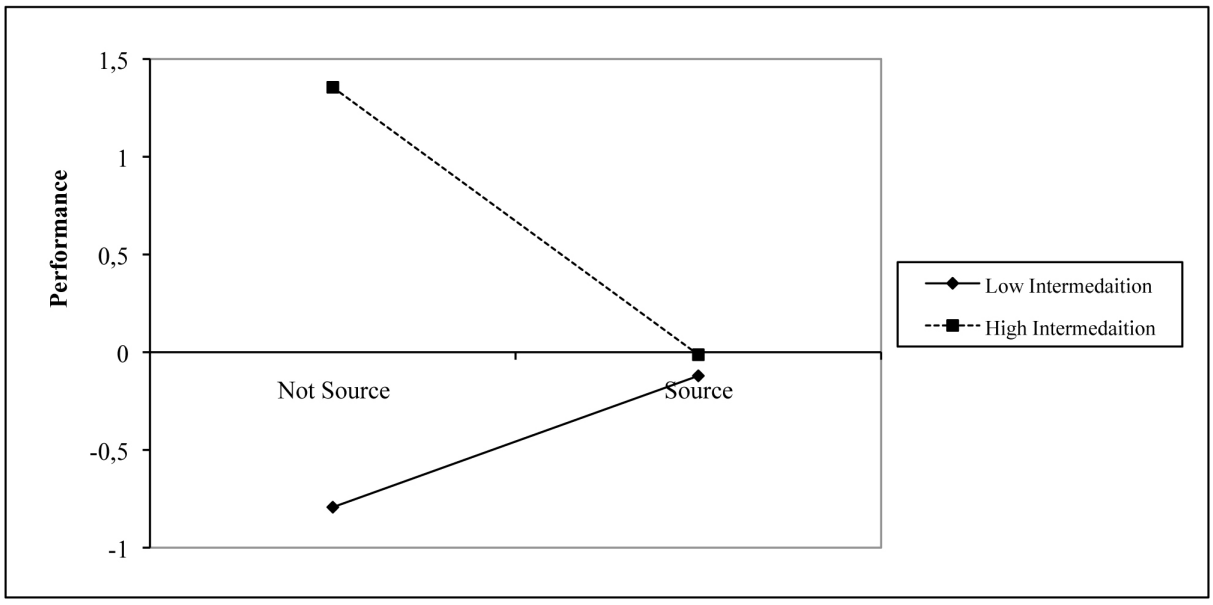
	Model 1		Model 2		Model 3		Model 4	
	B	**Error**	**B**	**Error**	**B**	**Error**	**B**	**Error**
Constant	.000	.078	.000	.075	.000	.071	-.044	.047
Previous Performance	-.029	.079	-.032	.075	.016	.073	.001	.048
Size	.005	.079	.024	.075	-.137	.082	.002	.055
Mutual exchanger			0,306***	.075	0,266***	.072	0,129***	.049
Intermediation					0,338***	.082	0,129**	.056
Mutual exchanger * Intermediation							0,494***	.034
Adjusted R2	-0,011		0.077		0.161		0.634	
Sig. Change in F	-		***		***		***	

N=166; *** p<0.01; ** p<0.05; * p<0.1. Non-standard coefficients

4.1. Results for information sources

Our first regression analysis is based on information sources and the results obtained are shown in Table 3. The first output of this table is that the explanatory capacity of the model is relevant with an adjusted R^2 of 0.304. The results on the source variable indicate that being one of them has a negative effect on the performance compared with those firms that do not exchange information in this way supporting Hypothesis 1. Additionally the existence of an interactive effect is supported by a significant increase of R^2 from model 3 to 4. In fact we can see how this affects the source variable in model 4. To better appreciate this we include in our study a graphical representation where the Y-axis represents the dependent variable (Performance) and the X-axis shows the independent variable (Source) for high and low values of betweenness (Figure 2). From this representation we can see how being a source of information doesn't pay-off in terms of performance for high and low values of betweenness. In fact, the combination of not being a source with betweenness leads to much better results. These results are also in line with Hypothesis 2, as the betweenness has an interactive effect that influences the way the source variable affects the performance.

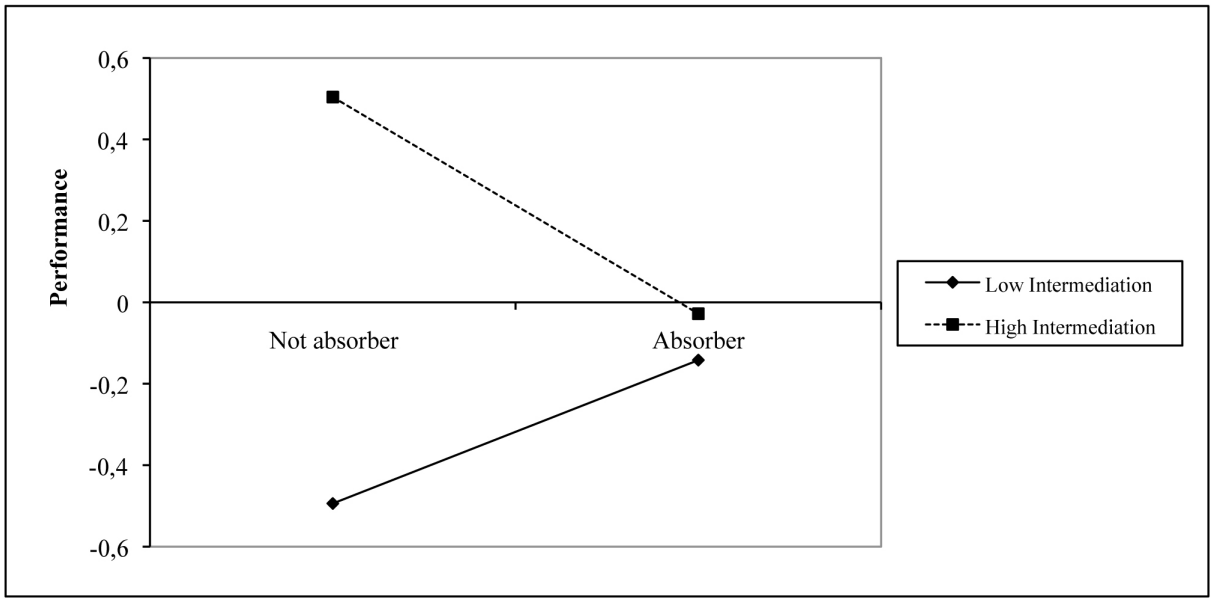
Figure 2. Interactive effects for information sources



4.2. Results for information absorbers

The second regression shows the results for information absorbers. On Table 4 we can observe that the explanatory capacity of the model is also significant but with the lowest adjusted R^2 among the three types of roles analyzed (0.109). It also shows how being an absorber does not have any significant effect on the performance contradicting our Hypothesis 1. In any case the increase of R^2 is significant between models 3 and 4 confirming the existence of an interactive effect of the betweenness variable on the absorber as we mentioned in Hypothesis 2. Even though the single independent absorber variable has no significant direct effect we have plotted out the moderation in Figure 3 as we have done before mainly because the interaction variable is significant.

Figure 3. Interactive effects for information absorbers

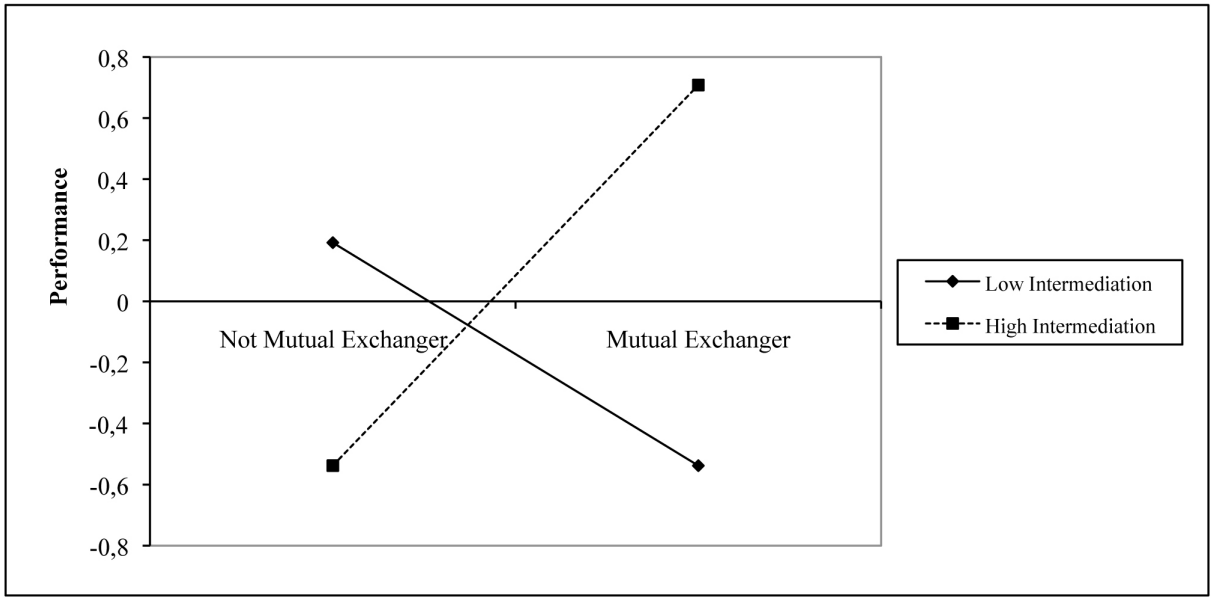


From this graphical representation we see almost the same pattern as we have shown in the source case. Performance wise the combination of high betweenness and not being absorber has the best influence on the performance.

4.3. Results for mutual exchangers

The last regression model is the one that measures the effects of being a mutual exchanger on the firms' performance. The first remarkable result comes from the highest significance of the model with an adjusted R^2 of 0.634. As it happened with the two previous models the moderating effect is also validated by the significant increase of R^2 from model 3 to 4. The main difference though comes through the fact that being a mutual exchanger has a positive effect on performance as it can be observed in Table 5. To have a better view of the interactive effects on performance we show the last graphical representation on Figure 4.

Figure 4. Interactive effects for mutual exchangers



In contrast to what happened in previous cases this time being a mutual exchanger is better for firms' performance and this effect is amplified for higher betweenness values. In other words firms that have strong intermediating behavior and balance accurately their information exchange can enhance their performance.

5. Discussion and Conclusions

The aim of this paper was to examine two research questions: (1) What is the association between differing firms' roles in the "cluster knowledge system" and its performance implications and (2) the moderating effect of the firm's intermediation in the "cluster knowledge system" on the association between differing firms' roles and its performance.

Overall our paper contributes to both, the specific cluster literature and research in the field of networks. With regard to the specific cluster literature, the paper sheds light on the processes that clustered firms could use to enhance performance. Our results show that their roles and intermediation in the cluster system of knowledge have different implications for their performance. Being a mutual exchanger has positive implications for the firm performance, whereas being a source has a negative impact and the absorber role per se is not associated with performance. Further, the firm's intermediation in the cluster system of knowledge changes these prior assumptions, so that it enhances the positive performance effect of being a mutual exchanger and links the two alternative roles to performance.

These findings also add to recent research in the field of networks. On the one hand evidencing the effects on firms' performance derived from the balance between what a firm provides and receives from its network of knowledge relations. So far, authors have mostly focused on the role and implications of the focal organization as receiver of external resources from networks, without considering a more complex and holistic view, including both the role of the focal organization as receiver and also as source of resources in the exchanging context, as we seek to present in this paper. On the other hand, the results support the importance of firms' positions in the network, particularly a firm's intermediation in a knowledge network.

5.1. Limitations and Future Research

This research is not exempt from limitations. First the empirical work on which this paper is based refers only to a specific industrial cluster, the ceramic industry. Therefore the particular characteristics of the case study make complicated the generalization of the results to other industrial realities. However, the amplitude of the sample used dispels doubts about the robustness of the analysis. Finally, our work is also limited by the fact that our data refer to a specific moment in time and therefore should be complemented in the future with new empirical measurements that allow for a longitudinal analysis of the issue.

To conclude our work we suggest a number of issues that could be part of future research. In this paper we have shown that the role companies have in the cluster knowledge system influences their business performance. However it would be interesting to investigate in more detail about these roles effects especially in their medium and long term. Also in this paper we have analyzed specific exchanges like business information. Therefore it might be interesting to extend the study to networks that exchange, for example, technological knowledge in line with some recent studies (Morrison and Rabellotti 2009). Finally, we believe that it would be interesting to compare these results with other industrial clusters.

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